Blowby Sensor

For Engine Testing

By Performance Trends

The most common checks for piston ring sealing are cranking compression and leak down. Both of these can falsely indicate a problem if a small amount of debris is preventing a ring from setting in the ring lands correctly or holding open a valve. The next check you do could show everything is fine. You also do not get a real *measure* of how well this engine seals up compared to that last engine you built. Neither of these check ring sealing *while the engine is running*. Now with Performance Trends' affordable Blowby Sensor, you can actually measure CFM of blowby during your dyno tests.

Hook up the blowby sensor to your valve cover following the instructions on back of this sheet. Hook up the electrical lead to one of Performance Trends's DataMite data loggers. Pick the built in Blowby Sensor calibration for your range of sensor and you're ready to test measure the CFM of blowby from your engine at all engine RPMs. Now you can get a history of your engines' blowby levels. For example: last year you were running 3.3 CFM at 4000 and 3.7 CFM at 7000 RPM. This year with your new boring technique, you're down to 2.2 CFM at 4000 and 2.3 CFM at 7000. *Now you can really measure if you are going in the right direction.*

Other features include:
- Large 1" diameter inlet and outlet to be able to handle 1000+ HP engines.
- Rugged, all aluminum construction.
- Five (5) flow ranges available to handle most any size engine with good accuracy. Custom ranges available.
- Can measure small flows in the reverse direction. This is good for diagnostic work and is used by the Performance Trends' DataMite software to warn meter may be installed backward.
- Can be used in any dyno system which provides 5VDC power, can measure a 0-5 volt output and allows you to type in a calibration table of CFM for various voltage outputs.

Optional Blow By Readout
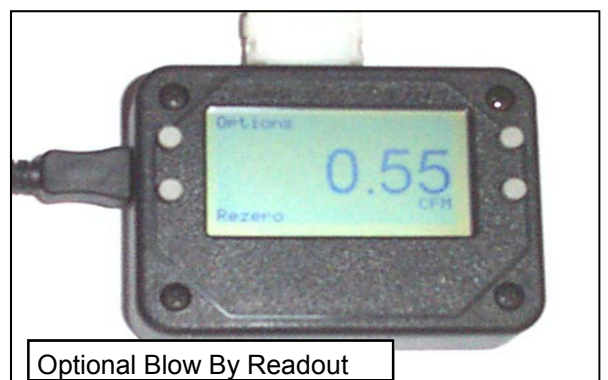
Blow By Sensor Installation Tips

The Blow By Sensor lets you measure the CFM flow from your crankcase. To be accurate you should seal up the crankcase, valve covers, etc. You should eliminate any type of PCV valve, or routing of the crankcase vapors out of the engine. Typically you will have the breather of one rocker cover as being the only outlet of blow by gasses.

You will route this outlet to the inlet of the Blow By Sensor with a long (6 ft, 2 meters or more), large diameter (5/8", 14 mm or larger), non restrictive hose. This helps protects the sensor from engine heat and helps isolate it from engine vibration. After the sensor, vent these gases with a large diameter, non-restrictive hoses to a safe, well ventilated area. **Blow by gases are exhaust which has passed by the piston rings and should not be breathed.**

The Blow By sensor should be mounted approximately level, with the side with the 2 ball plugs on top. The round section with the notch for the sensor lead is the upstream side of the sensor. See Figure 1. The label's arrow will show this also.

Because the sensor is very sensitive, you want to isolate the sensor from engine vibration. This is accomplished by keeping the hose between engine and sensor long (6 ft or more) to keep space between the engine and sensor. On 1 cylinder engines, because of strong crankcase pressure pulsations, you will likely want to put extra volume (a plenum) in this line. See Figure 2. This volume should be quite large, about 10-20 times larger then the engine displacement (200 cc engine needs 2000 to 4000 cc plenum, 2-4 liters or about 0.5 to 1 gallon).

The sensor may collect liquid from condensation and oil vapors. You should periodically check by removing hoses and letting hoses drain, and tipping condensation out of both sides of sensor. When moving sensor which has accumulated liquid, be careful to keep the ball "plugs" up, so liquid can not get to this top side of the channel inside the meter.
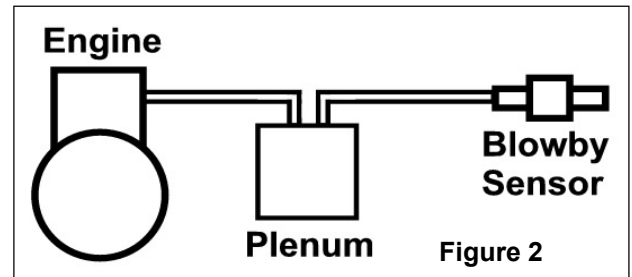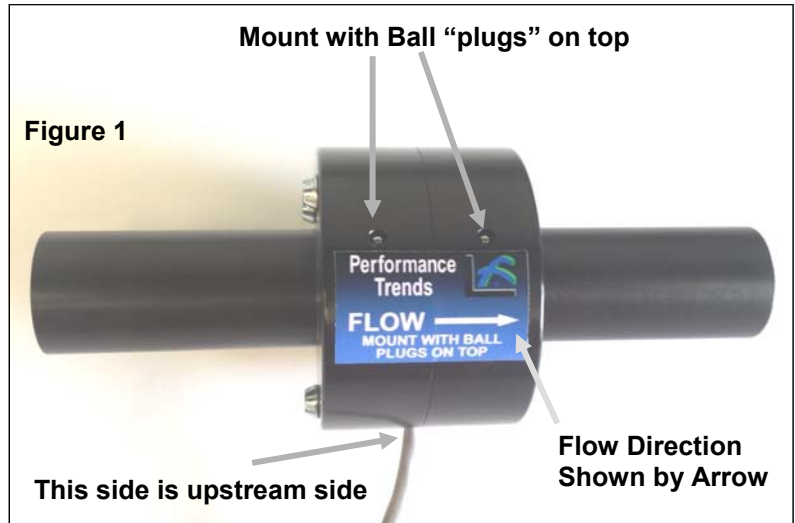
In the DataMite software, pick Blowby Sensor as the Type, and then enter the Range for your particular sensor as shown in Figure 2. In older versions of the software or non-Datamite applications, you must enter a table of values because the response is non-linear. Contact Performance Trends for this table.

You can type in any Data Name you want.

The Blow By Sensor **does** put a small restriction on the blowby flow, and therefore does put a small pressure on the crankcase. A signal of 2 volts (about half full scale CFM) will produce 0.15 psi pressure. At full scale of 5 Volts (full scale CFM), the pressure will be about 0.6 psi.

For non-DataMite wiring to customer's connector:

- Black is ground (bare shield wire can be connected to ground also, or cut off)
- Red is 4.75 to 5.25 V power
- White is signal (A 47uF cap can be connected between black and white to stabilize signal. If blue capacitor is supplied, the indented end goes to white wire. Some capacitors have a black bar arrow showing a "-". This arrow points to the end which goes to the black wire.)

Figure 1

Mount with Ball "plugs" on top

Performance Trends

FLOW →
MOUNT WITH BALL PLUGS ON TOP

This side is upstream side

Flow Direction Shown by Arrow

Figure 2

Engine

Blowby Sensor

Plenum

Click on DataMite

Choose Blowby Sensor as the Type.

Enter Blowby (or something similar) as the Data Name.

Enter the Range of your sensor, in this case 3 CFM.

Click on Sensor and Calibration for channel you have the Blowby connected to.

When done, click on Keep Specs.

Blow By Sensor.pub

Blowby Logger: Quick Start

The Blowby logger will display blowby flow ifor your blowby sensor on it's LCD screen. There are several options which you can select to customize the logger for your particular needs. The screen features are shown below:

Press the Options button for menu to select features and customize the logger

Press the Rezero button zero out the display with NO FLOW going through the blowby sensor. It will ask you to press one of the buttons on the right side of display once you have 0 flow.

Battery Indicator. If moving "+", then battery is charging via USB cable. If "[-----]" then battery is fully charged. If "[-]" battery very low and may turn off power quickly to maintain battery power and save any recorded data.

If you have selected to all the Recording Mode, you can press the Start Recording button to start recording blowby. Once recording has started, this label changes to "Stop Recording". Then you press this same button to stop recording. Click on the Options button, then Recording, then Playback to display the recorded blowby data.

Press the Sleep button to turn off the logger into "sleep" mode and save the battery. Turning to Sleep also saves any recorded data. **Turning off power with latching button on side of logger extends battery life best, but you will lose recorded Blowby data.**

Setting up your Logger for the First Time

1) Press Options, then Reset Defaults to restore all the logger's settings to their standard settings and use right side buttons to choose Yes, then press Select button. (NOTE: Once you have set up your logger, do *NOT* Reset Defaults as you may loose some special settings you like.)

2)   Press Options, then Meter Rating and select the size of your Blowby Sensor, from:

| _____ | 3 CFM | _____ | 6 CFM | _____ | 12 CFM |
| _____ | 18 CFM | _____ | 1 CFM * | _____ | 0.3 CFM * |

Then press the Select button. Then press Back button (upper left) to return to the main display.
* If you choose one of the lower ranges, you may want to reduce the Dsply Thres (display threshold), which is the lowest CFM displayed, typically set to 0.1 CFM. For example, for 0.3 CFM Rating, reduce Dsply Thres to 0.03 or so.

3) When back at main display, press the Rezero button (lower left) and then press one of the right buttons with NO FLOW through the sensor after the system has fully warmed up (been on for 5 min or so). NOTE: The sensor is quite sensitive, and changing the mounting orientation can change the reading when rezeroing. Therefore, rezero the sensor with the sensor in its final mounting position. Also, try to isolate it from vibration by providing a long hose (3 ft or 1 meter or more) between the engine and the blowby sensor. This hose should be 0.6" ID minimum; 1.0" ID is best.

Notes:
- You will charge your logger via the USB cable to any computer's USB port.
- You can upload your recorded data to the free Blowby Logger software on Performance Trends website or from CD.
- The logger will shut down automatically if it senses it is not moving, to save battery power.
- The LCD backlight will shut down automatically if it senses it is not moving, to save battery power. The time to keep the light on can be modified in the Options menu.
- The logger will mark each recorded data set with date and time. This is available by going into Options, then Recording, then Time/Date. If it has not yet been set, this can be done with the free software under Options.
- If you are not using the system for more than a day or so, it is best to disconnect th 8 pin harness to the sensor to further save battery life. The sensor puts a small current draw on system even in sleep mode. Pressing the latching power switch on the side extends battery life the best, but you will lose recorded data.

Blowby Logger Options Menu Operation

Main Screen Display

Press for Options Menu shown below

RPM reading if RPM recording turned On

To rezero blowby reading

Press to start recording data if logger is in Recording Mode.

Press to put into "sleep" mode and save battery power.

Power On/Off button for long term storage extends battery life best, **but you lose recorded**. **data**. It also "reboots" logger.

Screen display:
Options   Start Rec.
1.07
RPM 0   CFM
Rezero   Off

Options Menu

Press to return to Main Screen

Cursor Arrow showing current selection

Press this button to select option or value currently selected by the cursor arrow.

This button moves arrow cursor up.

This button moves arrow cursor down

Screen display:
Back   1.23 CFM
->Recording
Backlight
Reset Defaults
Meter Rating
Units
Filter
Select   Advanced Cal

Backlight Time Menu (showing how picking an option works)

Press to return to Options list **WITHOUT** keeping your change

Cursor Arrow showing current selection

Press this button to select option or value currently selected by the cursor arrow and return to Options Screen with your selection saved.

This button moves arrow cursor up in list.

This button moves arrow cursor down in list

Tapping these buttons move cursor 1 step at a time. Holding these buttons move cursor quickly through list.

Screen display:
Back   1.23 CFM
12
11
->10 minutes
9
8
Select

Playback Mode for Recorded Data

At main screen, press Options, then Recording, then Playback.

Data can also be uploaded to a PC via the free Performance Trends software.

Seconds in first column and blowby in second column.

Press these buttons to scroll through the recorded data. Different recording sessions are separated by dashed lines.

RPM data if RPM Recording Is turned On.

Screen display:
Back   1.23 CFM
1.2: .94   3455
1.3: 1.11 3489
1.4: 1.23 3492
1.5: 1.19 3513

Record Time, seconds

Blowby Flow

Blowby Logger Options Menu Operation, cont

Explanation of some menu options: Most of the menu options are quite obvious. For example, under Options you have Record and then Recording Mode and the options are Recording Off or Recording On. Turning this to On allows you to record data by pressing the Record button (upper right of main screen). Without turning this On, there is no Record label for that button on the main screen.

However, some can be confusing and they will be explained here.

Off button at lower right corner of display reduces power consumption. Pressing latching button on side cuts off battery power completely, extending battery life the best, but **you will lose any recorded data**.

Options, Recording, Recording Rate explains that the record rate (how many readings per second) is determined by the Filtering setting. If Filtering is None, the rate is 10 samples per second. If Filtering is 1 second, the rate is 1 sample per second. The logger will record for either 1240 data readings (124 seconds at 0.1 rate, or the time set under Backlight/ Pwr for Inactive PwrOff.

Options, Recording, Include RPM lets you include RPM in the data recording. You may need a special cable and sensor from Performance Trends to do this.

Options, Recording, Pulses/Rev lets you specify how many pulses you get for every revolution of what you are measuring. If you have 1 magnet on the shaft, then this would be 1. If you are getting a tach pulse (special signal conditioning from Performance Trends may be required), then this could be 0.5 for a 1 cylinder, 4 stroke which fires every 2nd revolution. For a V-8 4 stroke, this would be 4.

Options, Backlight/Pwr lets you specify options to save on the battery life.
- BackIt On With lets you specify if motion of the logger or pressing a button will turn on the backlight.
- Backlight Time lts you specify how long the backlight will stay on after being activated.
- InactivePwrOff lets you specify how long the box can have no motion or button press or USB communications before the box "goes to sleep" to save on power. **IMPORTANT: This time is also the maximum recording time the logger will log data. If you want to record for the maximum time, set this to 20 min.**
- Low Bat PwrOff lets you specify how long before the box goes to sleep when the battery power is very low.

Options, Reset Defaults puts the logger back to all factory settings. This can be very useful if you think you have made mistakes with the settings. NOTE: After this you must select the proper Meter Rating. 6 CFM is the default which may not be correct for your blowby sensor.

Options, Meter Rating is a critical setting and must be set for your blowby meter rating, typically 3, 6 and 12 CFM, but other ranges are available.

Options, Filter lets you specify how many readings are averaged together to obtain the final blowby reading displayed. If you select None, only 0.1 seconds of blowby readings are averaged together. If you select 2 Seconds, the 2 seconds are averaged together and the display is only updated every 2 seconds. If you have set Recording Mode to On, then any data you record is recorded only every 2 seconds also. Note: This is different than recording a data point every 2 seconds, where that particular data point may be a "flyer" or "outlier". This method of averaging several readings together produces much more repeatable, accurate results. If the engine is accelerating or changing load, typically None is best. If the engine is running at steady conditions, increasing this may be more accurate. Because of limited memory in the logger, if you need to record blowby for a long period of time, you must increase this to the maximum of 5 seconds.

Options, Advanced Cal let you change the calculations converting voltage reading into blowby flow.
- UEK1 should only be changed if directed to by Performance Trends.
- UEK2 should only be changed if directed to by Performance Trends.
- Square Root should only be changed if directed to by Performance Trends.
- Dsply Thres lets you change the minimum flow which will be displayed. At very low flow, or even now flow, minor changes in the blowby sensor's mounting angle, vibration, etc can be registered as a small flow. Because the small flow can actually be in error, the display typically does not show an actual flow reading until it has gone above some minimum lever.
- Output Factor lets you increase or decrease the flow displayed by a certain factor. For example, if you have calibrated your blowby sensor against some other sensor and the blowby sensor is reading low by 5%. You can change this factor from the default of 1 (no change) to 1.05 to increase all readings by 5%. Now a reading of 3.00 CFM will actually be displayed and recorded 3.15 CFM.

Blowby Analog Output

The Blowby Logger can produce a linear voltage proportional to the Blowby Reading. If you have a 6 CFM Blowby Sensor and have set that in the Blowby Logger, then 0-6 CFM is **0-4 volts**. The output goes up to 5 volts and is accurate above 4 volts. In the case of 0-6 CFM, 5 volts would be 7.5 CFM. If you have selected Units as LPS (liters per second), the scale is still 0-6 LPS is 0-4 volts. The 0-6 CFM range is approximately 0-3 LPS. That means the full scale LPS will occur at approximately 2.0 volts analog output.

If you have a Performance Trends DataMite logger for reading the linear Blowby signal, then a DataMite sheet will tell you how to hook up and calibrate that particular channel.

If you have some other type of logger, then you will be supplied with a mating connector for the 4 pin analog output from the logger. This is typically a connector on a lead about 2 feet long coming out of the Blowby Logger's 8 pin connector.

The mating connector sent will have 4 positions for terminals, but only 2 terminals are used. The terminals will be male pins to fit into the female terminals in the loggers connector.

Wire the connector to your logger using the pinouts below:
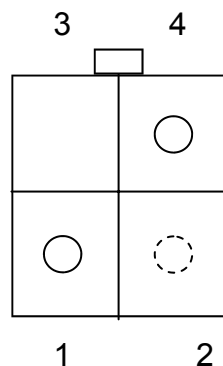
Pin numbers are visible from the back of the connector. When you wire up, make sure the pins match up with the sockets on connector on Blowby Logger harness.

    Pin 1 is ground
    Pin 2 Optional, 5 volt power in. This power MUST be regulated to be
        5.0 volts, +/- 0.1 volts. See warning below.
   Pin 4 is 0-5 volt output, 20 mAmp max.

Because of the various amount of current draw your logger may put on the Logger, it is recommended you keep the logger powered up via USB cable.

IMPORTANT: If you wire up to Pin 2, you must be careful to NOT power up via the USB and you MUST also remove the battery. Contact Performance Trends before trying this. A battery overload and fire hazard are possible.

Performance Trends'
Blowby Sensor
With Optional Recorder
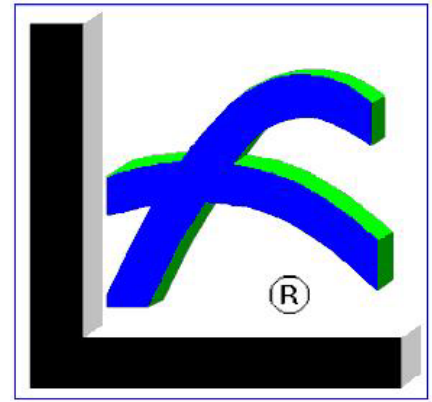
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Hook up the blowby sensor to your valve cover following the instructions with your sensor. Hook up the electrical lead to one of Performance Trends' DataMite data loggers. Pick the built in Blowby Sensor calibration for your range of sensor and you're ready to test measure the CFM of blowby from your engine at all engine RPMs.

Now you can get a history of your engines' blowby levels. For example: last year you were running 3.3 CFM at 4000 and 3.7 CFM at 7000 RPM. This year with your new boring technique, you're down to 2.2 CFM at 4000 and 2.3 CFM at 7000. Now you can really measure if you are going in the right direction.

Other features include:

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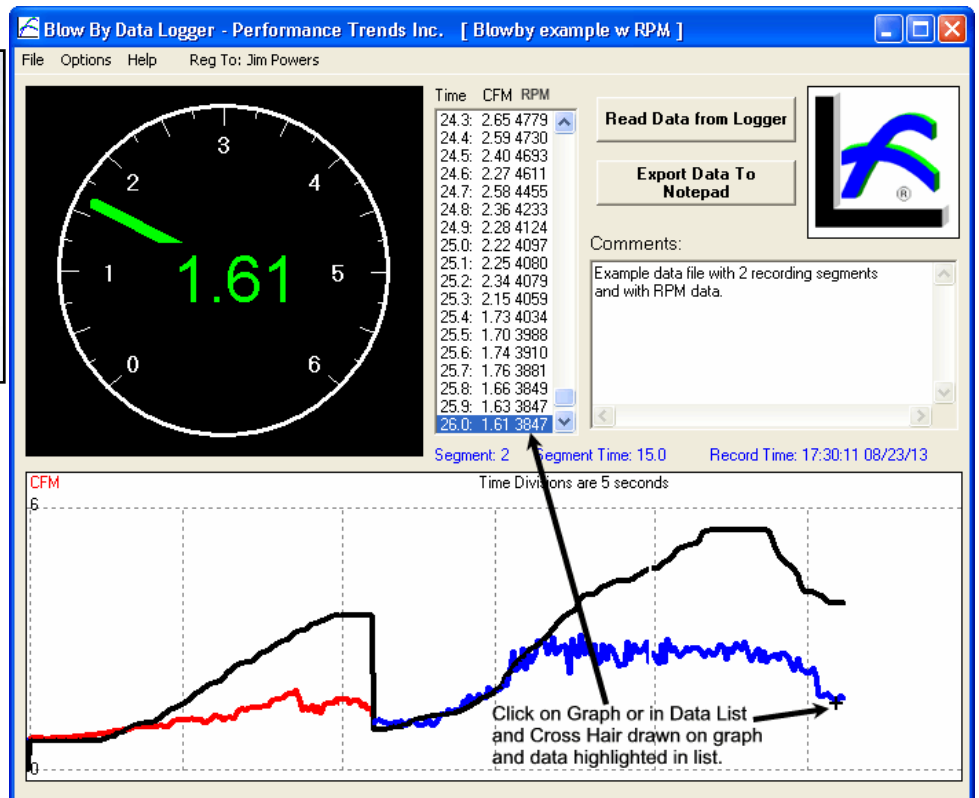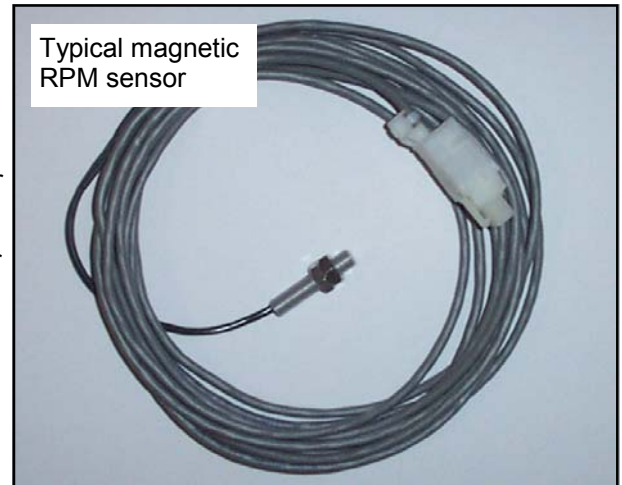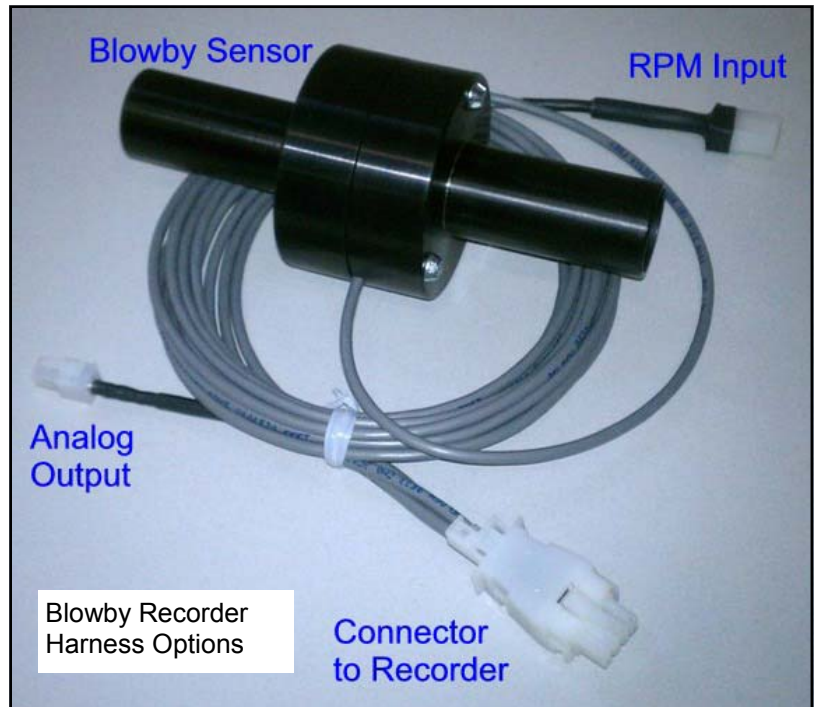
Performance Trends' DataMite software to warn meter may be installed backward. Can be used in any dyno system which provides 5VDC power, can measure a 0-5 volt output and allows you to type in a calibration table of CFM for various voltage outputs.

Blowby Recorder

This hand held device lets you display the blowby as either CFM (cubic feed per minute) or LPS (liters/second) without need of a data logger. You can also record blowby for as little as a few seconds or for up to an hour. Then you can playback your data on the Recorder, or download to the free Blowby Analyzer software for graphing, printing, saving, etc.

Blowby Logger's main features include:

- User selectable averaging time, from None (meaning 0.1 second readings to catch fast changes) up to 5 second averages for good average readings and long recording times.

- Recorder Options of Start and Stop recording, erasing data, and playback on the recorder.

- Free software lets you send recorded data to your PC for graphing, printing, saving, adding comments, and opening old data files (Win 98, XP, Vista, Win 7, Win 8).

- Display blowby readings as either CFM (cubic feet per minute) or LPS (liters per second).

- Option to provide a linearized 0-5 volt DC output signal for easier recording by third party data loggers, for example a dyno system or vehicle data logger. (Performance Trends' DataMite loggers can record the standard non-linear output with no problems.)

- Rechargeable lithium Ion battery for long life and charging via USB cable to PC.

- Advanced Calibration factors let you fine tune your blowby meter's calibration.

- RPM input to allow recording RPM with blowby.

Blowby Sensor · RPM Input · Analog Output · Blowby Recorder Harness Options · Connector to Recorder

Typical magnetic RPM sensor

Sample of Recorder Output

```
File: Blowby example w RPM
------------------------------------------------------------
Comments:
Example data file with 2 recording segments
and with RPM data.


------------------------------------------------------------
 Seg    Seg Time    Time    CFM    RPM    Record Time/Date
 1      0.1         0.1     0.74   674    17:29:26 08/23/13
 1      0.2         0.2     0.73   674    17:29:26 08/23/13
 1      0.3         0.3     0.73   674    17:29:26 08/23/13
```